

## Identification of Termites of Saudi Arabia<sup>1</sup>

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**ABSTRACT.** Based on the morphological characters of worker and soldier mandibular dentition and wing venation of alate forms, differentiation was made among 11 species of termites commonly found in Saudi Arabia: *Anacanthotermes ochraceus* (Burm.), *A. ubachi* (Navas), *A. vagans* (Hagen), *Psammotermes hybostoma* Desneux, *Microcerotermes gabrielis* Weidner, *M. parvulus* (Sjostedt), *Amitermes messinae* Fuller, *A. vilis* (Sands), *Eremotermes sabaeus* Harris, *Microtermes najdensis* Harris, and *M. yemenensis* Wood.

Much attention has been paid to the external anatomy of termites as a basis for systematics and classification. Among the most important of these characters are the dentition of imago-worker mandibles (Ahmad 1950, Emerson 1960 and Harris 1971); soldier mandibles (Sands 1957, Weesner 1969 and Harris 1971); wing venation of alates (Fuller 1919, Tillyard 1931 and Weesner 1969); external genitalia (Roonwal 1956 and Tuxen 1956), and chaetotaxy of castes (Kushwaha 1960). The internal anatomy has been also given consideration in phylogenetic studies (Krishna 1970).

Soldiers and winged forms seem to be essential for the classification of termites. This is due to the more obvious changes displayed in soldiers than in other castes, as well as to the differences in size, shape, colour and wing venation of alates (Weesner 1969). Differences between individual workers of the same species

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1. This material is based upon work supported by King Abdulaziz City for Science and Technology, under grant No. AR2-005.

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may in certain cases be greater than between different species of one genus (Nichols 1931 and Roonwal and Sangal 1950).

In Saudi Arabia, there has been no documented reference on termites before Sands forwarded his list to the Ministry of Agriculture and Water in 1971. The list included nine species belonging to the genera *Anacanthotermes*, *Psammotermes*, *Heterotermes*, *Microcerotermes*, *Amitermes*, *Microtermes* and *Trinervitermes*. Several attempts to collect and identify termites from different regions then followed, and several species were added to the termite fauna of the Kingdom (Nasr *et al.* 1978 and 1980, Chhotani and Bose 1979 and 1982 and Badawi *et al.* 1982). In a 3-year survey covering almost all regions of the country, 12 species of termites with notes on their hosts and distribution were given (Badawi *et al.* 1986).

Based on mandibular dentition of soldiers and workers, and on wing venation of alates, differentiation was made between the three castes of 11 species of termites commonly found in Saudi Arabia.

### Material and Methods

Termite specimens were collected from almost all regions of the country and preserved in 70% alcohol. After being identified, permanent mounts were prepared following the normal routine method (Weesner 1968). Either whole mounts were prepared, or mandibles were severed by a fine needle and mounted. Using a micrometer eye-piece, measurements were taken of the lengths of mandibles.

For studying the wing venation in alates, wings were clipped, placed on a drop of water on a glass slide so that folded wings would expand, then left to dry. A cover slide was placed on the wing and fixed in position by fine droplets of Canada balsam added to its corners. Drawings were made with the use of a camera lucida.

### Results and Discussion

The 11 species of termites commonly encountered in Saudi Arabia and discussed here are: *Anacanthotermes ochraceus* (Burmeister), *A. ubachi* (Navas), *A. vagans* (Hagen), *Psammotermes hybostoma* Desneux, *Microcerotermes gabrielis* Weidner, *M. parvulus* (Sjostedt), *Amitermes messinae* Fuller, *A. vilis* (Sands), *Eremotermes sabaeus* Harris, *Microtermes najdensis* Harris and *M. yemenensis* Wood.

***Anacanthotermes***

*Worker* (Fig. 1, a-c).

Mandibles, almost similar in dentition in the three species, with slight differences in size. Only *A. ochraceus* will be discussed.

Left mandible  $0.94 \pm 0.011$  mm long, with an apical and three marginal teeth. Apical and first marginal very close together. First and third marginals separated by a flattened cutting edge representing second marginal. Distance between first and third marginals and between the latter and molar plate being  $0.35 \pm 0.003$  and  $0.11 \pm 0.007$  mm respectively.

Right mandible  $1.03 \pm 0.060$  mm long, with an apical and two marginal teeth (Weesner 1969). First marginal larger than either apical or second marginal. Posterior edge of second marginal straight, more than twice as long as anterior edge. Molar plate smooth.

Measurements given by Harris (1967) for *A. ochraceus* from Algeria and Southern Arabia, *A. ubachi* from Jordan and Iraq and *A. vagans* from Iran and Afghanistan are in most cases larger than those from Saudi Arabia.

*Soldier* (Fig. 2-a,b)

Left and right mandibles  $2.11 \pm 0.15$  and  $1.99 \pm 0.14$  mm long respectively in *A. ochraceus*, 2.01 and 1.86 mm long, respectively, in *A. ubachi* (one individual). Soldiers of *A. vagans* not available.

Left mandible with an apical and three marginal teeth (Weesner 1969). Two marginal teeth present in right mandible. Anterior edge of first marginal of right mandible with a small hump and forms almost a right angle with apical tooth in *A. ochraceus*, with no hump and with angle acute in *A. ubachi*. Molar plate of right mandible highly sclerotized in both species.

*Wing venation* (Fig. 3-a)

For wing: anterior edge heavily sclerotized forming costal margin (not a true vein). Precosta and Costa absent (Emerson 1960). ( $R_1$ ) heavily sclerotized, four-branched, branches join basal half of costal margin. ( $R_s$ ) with three heavily sclerotized branches directed towards costal margin, and seven weak branches directed towards wing apex. ( $M$ ) weak, occupies mid area of wing membrane, with three branches directed to posterior wing margin. ( $Cu_1$ ) occupies posterior basal area of wing, with many branches sent to basal half of posterior margin of wing. Anal veins lacking.

Hind wing: more or less similar to fore wing but (Rs) is less branched. (M) arises from (Rs) in the wing membrane.

### ***Psammotermes***

#### ***Worker*** (Fig. 1-d)

Left mandible  $0.41 \pm 0.015$  mm long, with an apical and three prominent marginal teeth. Apical and the following two marginal teeth close together, first marginal being the shortest. Anterior edge of third marginal much longer than posterior edge (more than twice as long). Molar plate irregular.

Right mandible slightly longer than the left ( $0.45 \pm 0.015$  mm long), with an apical and two marginal teeth. With a small subsidiary tooth at base of anterior cutting edge of first marginal. Posterior margin of second marginal tooth flattened, forming a cutting edge, four times as long as anterior margin. Inner surface of molar lobe smooth.

#### ***Soldier*** (Fig. 2-c,d)

Of two types, major and minor, fontanelle present in both.

Major soldier (Fig. 2, c): Left and right mandibles robust, curved, equal in length ( $1.47 \pm 0.045$  mm each). Left mandible with five to seven marginal teeth. Right mandible with only four to five teeth.

Minor soldier (Fig. 2, d): Left and right mandibles equal in length ( $0.98 \pm 0.045$  mm), more or less similar in shape and dentition to major type.

#### ***Wing venation*** (Fig. 3-b)

Fore edge supported by two parallel, heavily sclerotized veins designated as (Sc + R), followed by (Rs) (Weesner, 1969).

Fore wing: (M) inconspicuous, very faint or absent. (Cu) much branched, occupies a central position in wing membrane. Posterior wing margin (base to apex) occupied by terminal branches of (Cu).

Hind wing: (M) weak, arises from base of (Rs), occupies an anterior position in wing membrane, terminates at its tip. (Cu) occupies posterior half of wing membrane, with numerous branches sent to posterior wing margin (from base to apex).

### ***Microcerotermes***

#### ***Worker*** (Fig. 1-e,f)

Left mandible  $0.35 \pm 0.006$  mm long in *M. gabrielis*,  $0.30 \pm 0.001$  mm in *M. parvulus*. With an apical and two prominent marginal teeth (first and third

marginals). Second marginal tooth absorbed to form a concave cutting edge. Molar plate smooth in both species.

Right mandible  $0.33 \pm 0.006$  mm long in *M. gabrielis*,  $0.29 \pm 0.003$  mm in *M. parvulus*, with an apical and two marginal teeth. First marginal, relatively larger than apical, both with pointed tips. Second marginal with bluntly rounded tip, its posterior edge being longer than anterior edge. Molar plate slightly ridged in the latter species.

*Soldier* (Fig. 2-e,f)

Mandibles symmetrical, sabre-shaped, equal in length. Inner margin finely serrated, serration much more obvious in *M. parvulus*. Mandibles long in *M. gabrielis* ( $1.15 \pm 0.015$  mm), almost of the same length of head capsule, straight, nearly parallel, with tips curved inwards. In *M. parvulus*, mandibles are short (0.78 mm -one specimen), almost half the length of head capsule, strongly curved inwards.

*Wing venation* (Fig. 3-c)

Fore wing: (M) slightly sclerotized, occupies mid area of wing membrane, bifurcates at a mid point of its length but slightly near to wing base. Branches extend to apex and outer portion of posterior wing margin. (Cu) not heavily sclerotized, occupies posterior basal third of wing membrane, with many branches sent to basal two-thirds of posterior wing margin.

Hind wing: more or less similar to fore wing. (M) less branched, fused to base of (Rs) in wing membrane, bifurcates at a mid point along its length but slightly nearer to wing apex.

***Amitermes***

*Worker* (Fig. 1-g,h)

Left mandible with an apical and a single projecting marginal tooth; the first marginal. Third marginal not projecting from face of mandible. Space between first and third marginals (representing second marginal) relatively shorter than in *Microcerotermes* or *Anacanthotermes*, flattened and modified to form a cutting edge.

Right mandible  $0.35 \pm 0.006$  mm long in *A. messinae*,  $0.36 \pm 0.006$  mm in *A. vilis*. With an enlarged and more pointed apical tooth, and two marginal teeth, the second not projecting from inner margin of mandible.

*Soldier* (Fig. 2-g,h)

Mandibles symmetrical, almost similar in both species in general shape and length ( $0.67 \pm 0.018$  and  $0.69 \pm 0.013$  mm long, respectively). Much shorter than

head capsule, stout, obviously curved inwards. Inner margin with a median tooth directed backwards, median tooth sharply pointed in *A. messinae*, bluntly rounded in *A. vilis*.

*Wing venation* (Fig. 3-d)

Hind wing only available, similar in venation to *Microcerotermes*, but (M) less branched and bifurcates at a mid point along its length.

***Eremotermes***

*Worker* (Fig. 1-i)

Left mandible  $0.31 \pm 0.002$  mm long, with an apical and a single projecting marginal tooth (first marginal), the former being larger than the latter. First marginal, followed by a slightly concave edge representing second marginal. Third marginal inconspicuous. Molar plate smooth.

Right mandible almost equal in length to left mandible ( $0.30 \pm 0.002$  mm). With an apical and two marginal teeth, second marginal being the smallest. Molar plate corrugated.

*Soldier* (Fig. 2-i)

Mandibles symmetrical,  $0.80 \pm 0.018$  mm long, almost same length as head capsule, straight and nearly parallel, broad at base, tapering anteriorly. Tips curved inwards. Inner margin with a median tooth, fine, sharp, and directed posteriorly.

*Wing venation*

Alates of this species not available.

***Microtermes***

*Worker* (Fig. 1-j,h)

Left mandible with an apical and three marginal teeth. Second marginal flattened to form a cutting edge. Third marginal reduced, its anterior edge being at least twice as long as posterior edge. Molar plate smooth.

Right mandible with an apical and two marginal teeth. Posterior cutting edge of second marginal tooth straight, being at least three times as long as anterior edge. Molar plate smooth.

*Soldier* (Fig. 2-j)

Soldiers of *M. najdensis* only available. Mandibles symmetrical ( $0.66 \pm 0.060$  and  $0.67 \pm 0.060$  mm long for left and right mandibles, respectively), slender, inner

margin smooth, with no teeth or serrations, tips bent upwards.

*Wing venation* (Fig. 3-e)

Similar in fore and hind wings, but (M) in the latter arises from (Rs) in wing membrane. Costal margin supported by two highly sclerotized parallel veins; (Sc + R) and (Rs). (M) occupies anterior third of wing membrane, faint, bifurcates at about the outer third of wing, branches extend to apical margin of wing. (Cu) not heavily sclerotized, tends to occupy a central position, with numerous accessory branches (18-20) occupying the whole posterior margin.

**Key to Workers**

1. Left mandible with an apical and three prominent marginal teeth, first marginal being the shortest. Apical and following two marginals very close together. Right mandible with an apical and two marginals, with a small subsidiary tooth at base of anterior cutting edge of first marginal.....*Psammotermes*  
 Left mandible with an apical and two apparent marginal teeth (first and third), second marginal absorbed to form a cutting edge. Right mandible with an apical and two marginals, with no subsidiary tooth.....(2)
2. Apical tooth and first marginal of left mandible very close together ..... *Anacanthotermes*  
 Apical tooth and first marginal of left mandible not as above .....(3)
3. First marginal of right mandible smaller than apical, second marginal inconspicuous or very slightly projecting from inner surface ..... *Amitermes*  
 First marginal of right mandible larger than apical, second marginal clearly projecting from inner surface .....(4)
4. Left mandible with third marginal inconspicuous, right mandible with tip of second marginal pointed.....*Eremotermes*  
 Left mandible with third marginal apparent,

- right mandible with tip of second marginal  
smoothly rounded ..... (5)
5. Second marginal of right mandible with anterior and posterior edges of same length or the latter slightly longer than former. Molar plate slightly ridged ..... *Microcerotermes*
- Second marginal of right mandible with posterior edge straight, at least three times as long as anterior edge. Molar plate smooth ..... *Microtermes*

### Key to Soldiers

1. Right and left mandibles almost identical, similar in size, shape and dentition ..... (2)
- Right and left mandibles different ..... (4)
2. Inner margin of mandibles toothless or very finely serrated ..... (3)
- Inner margin of mandibles with a median tooth directed posteriorly ..... (5)
3. Mandibles finely serrated, taller than the length of head capsule or at least longer than half its length ..... (6)
- Mandibles toothless, shorter than half the length of head capsule ..... *Microtermes najdensis*
4. Left mandible with three marginal teeth, right mandible with only two ..... (7)
- Left and right mandibles, each with more than three marginal teeth ..... *Psammotermes hybostoma*
5. Mandibles almost straight and parallel ..... *Eremotermes sabaeus*
- Mandibles curved inwards ..... (8)
6. Mandibles slightly taller than head capsule ..... *Microcerotermes gabrielis*
- Mandibles shorter than head capsule ..... *Microcerotermes parvulus*
7. Anterior edge of first marginal of right mandi-

- ble with a small hump and forms almost a right  
angle with apical tooth.....*Anacanthotermes ochraceus*  
With no hump, angle acute ..... *Anacanthotermes ubachi*
8. Median tooth sharply pointed ..... *Amitermes messinae*  
Median tooth bluntly rounded ..... *Amitermes vilis*

### Key to Alates

1. Anterior edge of both wings heavily sclerotized  
forming costal margin, costal margin supported  
by (Sc) and branches of (R1) and (Rs) .....  
..... *Anacanthotermes*  
Costal margin supported by two heavily sclero-  
tized parallel veins, (Sc + R) and (Rs) ..... (2)
2. (M) inconspicuous, faint or absent in fore  
wing, unbranched in hind wing ..... *Psammotermes*  
(M) present, branched in both wings ..... (3)
3. (M) occupies an anterior position in wing  
membrane, its branches are directed towards  
wing apex ..... *Microtermes*  
(M) occupies mid area of wing membrane,  
branches being directed to apex and outer  
portion of posterior margin of wing ..... (4)
4. (M) of hind wing bifurcates at a mid point  
along its length ..... *Amitermes*  
(M) of hind wing bifurcates at a point nearer to  
wing apex ..... *Microcerotermes*

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(Received 16/12/1985;  
in revised form 07/05/1986)

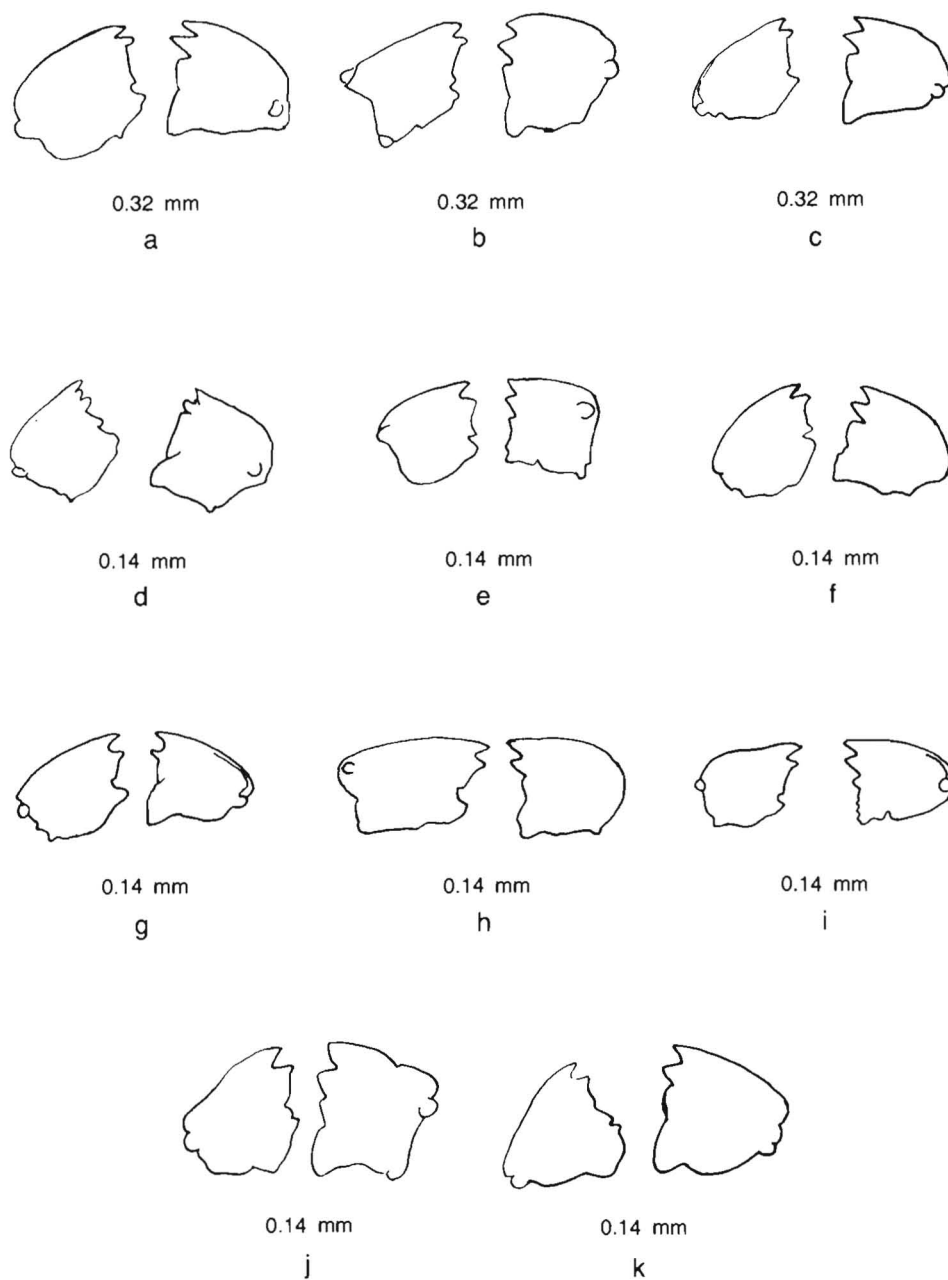
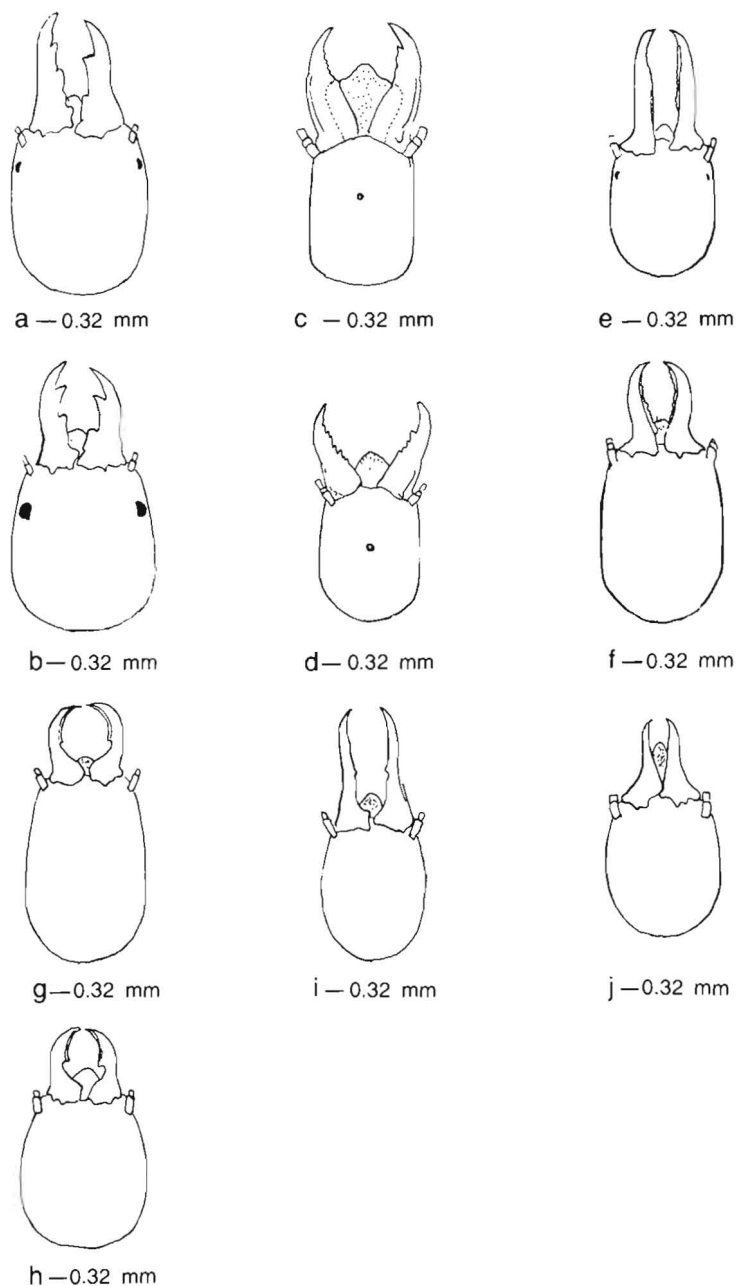


Fig. 1. Shape of worker mandibles:

(a) *A. ochraceus*, (b) *A. ubachi*, (c) *A. vagans*, (d) *P. hybostoma*, (e) *M. gabrielis*, (f) *M. parvulus*, (g) *A. messinae*, (h) *A. vilis*, (i) *E. sabaus*, (j) *M. yemenensis*, (k) *M. najdensis*.



**Fig. 2.** Shape of head capsules and mandibles of termite soldiers: (a) *A. ochraceus*, (b) *A. ubachi*, (c) *P. hybostoma*, major type, (d) *P. hybostoma*, minor type, (e) *M. gabrielis*, (f) *M. parvulus*, (g) *A. messinae*, (h) *A. vilis*, (i) *E. sabaeus*, (j) *M. najdensis*.

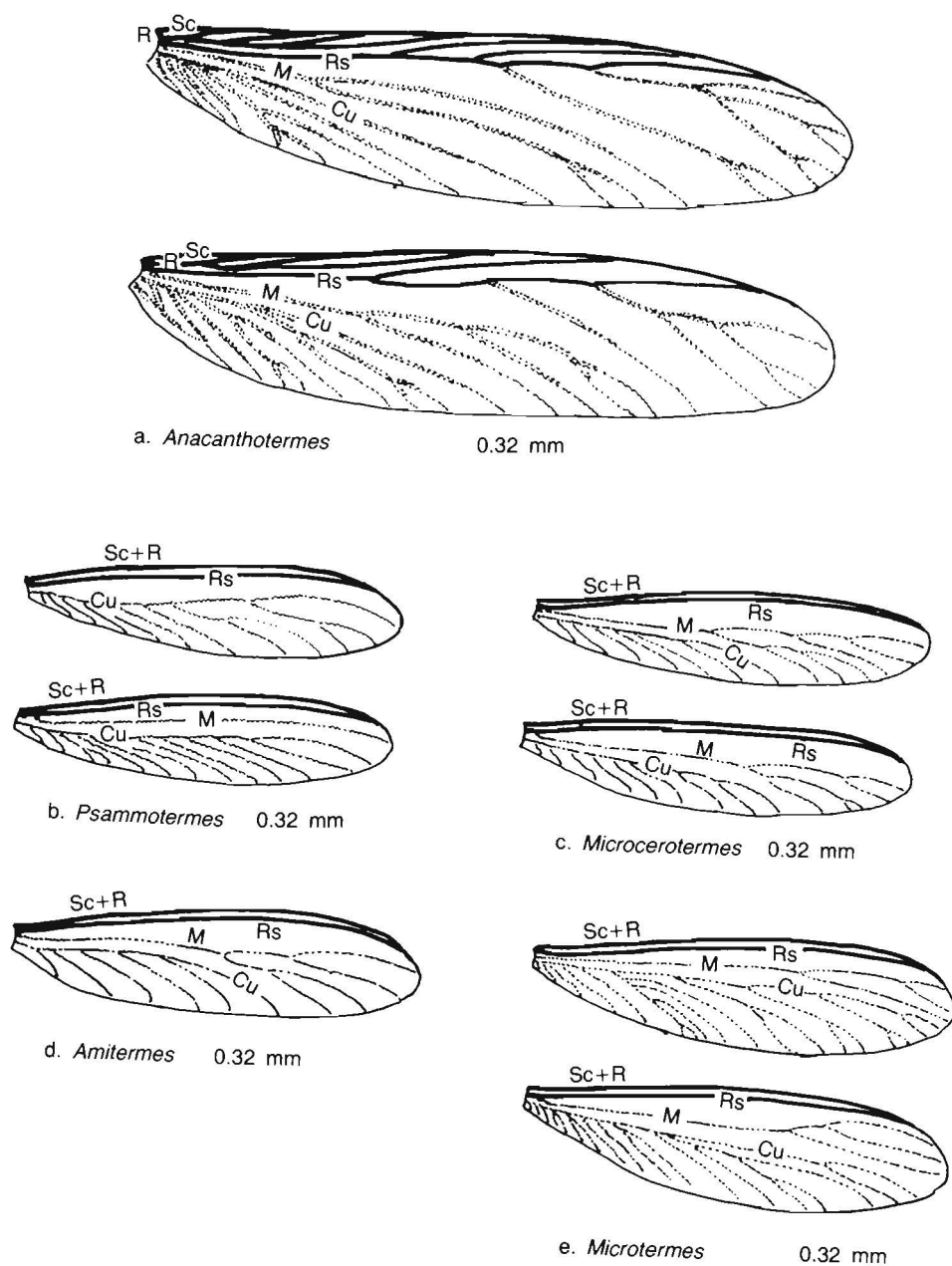


Fig. 3. Wing venation of termite genera: (a) *Anacanthotermes*, (b) *Psammotermes*, (c) *Microcerotermes*, (d) *Amitermes*, (e) *Microtermes*.

## تمييز النمل الأبيض في المملكة العربية السعودية

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أجريت هذه الدراسة لتمييز إحدى عشر نوعاً من النمل الأبيض تتبع ستة أجناس هي *Anacanthotermes* (ثلاثة أنواع) *Amitermes*, *Microtermes*, *Microcerotermes* (نوعان لكل منهم) *Eremotermes*, *Psammotermes* (نوع واحد لكل منهما). وقد تم جمع هذه العينات خلال عملية حصر شملت جميع أنحاء المملكة، وسميت تسمية علمية صحيحة في المتحف البريطاني للتاريخ الطبيعي بلندن، ومتحف التاريخ الطبيعي بهامبورج. وقد عملت تحضيرات مستديمة إما للحشرات كلها أو بعض أجزائها بعد فصلها (الرأس، الفكوك العلوية، الأجنحة).

وقد أمكن تحديد الصفات المميزة لأنواع النمل الأبيض اعتماداً على بعض الصفات المورفولوجية لكل من الشغالات والجنود والأفراد المجنحة. وقد اعتمد في تمييز الشغالات على شكل وأبعاد الفكين العلويين الأيمن والأيسر ونظام تسنيهما. كما تمت المقارنة بين الجنود على أساس شكل الرأس وأبعاده وشكل وأبعاد وتسني الفكين العلويين الأيمن والأيسر، كما اعتمد على نظام تعريق الجناحين الأمامي والخلفي في تمييز الأفراد المجنحة في حالة وجودها.